

Teruko NAKAMURA\* & Motoo NAGASAWA\*: **Variation in  
pollen grains of Japanese *Asiasarum* (Aristolochiaceae)**

中村輝子\*・長沢元夫\*: 日本産ウスバサイシン属植物の花粉の変異

The genus *Asiasarum* comprises four species and two varieties (Maekawa 1936) and occurs in north-eastern Asia such as China, Korea, Japan, Sakhalin and the southern Kurils. Three of the four species grow in Japan: *Asiasarum heterotropoides* (Fr. Schm.) F. Maekawa has been reported from the Tohoku district and Hokkaido; *A. sieboldii* (Miq.) F. Maekawa from Honshu and Kyushu; and *A. dimidiatum* (F. Maekawa) F. Maekawa from Kyushu, Shikoku and the Kii Peninsula (Hiura 1968). Our investigations of the essential oils of the Japanese *Asiasarum* demonstrated that the Japanese plants can be divided into three groups according to their monoterpenoid patterns (Nakamura et al. 1979, 1982, 1987).

The present study deals with the results of palynological investigations of Japanese species of *Asiasarum*. The exine ornamentation of pollen grains in the genus *Asiasarum* shows two types and the distributions of taxa with these two types of pollens will be discussed in this paper.

**Materials and methods** Localities of the samples collected are shown with the results in Figs. 2-5. Pollen grains were taken out from fresh anthers or from those kept in an electric refrigerator. After being coated with about 600 nm of gold, they were examined with a JEOL JSM-T20 scanning electron microscope at 20 kv, or a JEOL JSM-34 scanning electron microscope at 17 or 20 kv.

**Results** The exine ornamentation of pollen grains in *A. sieboldii* can be divided into two types. Type A is characterized by the smooth surface of the verruca (Fig. 1-A), while type B is characterized by the striate surface of it (Fig. 1-B). The former type was found in the following samples (Fig. 2): Yutagawa, Yamagata Pref. ; Mt. Zao, Yamagata Pref. ; Murakami, Niigata Pref. ; Tsuchiyu, Fukushima Pref. ; Sandogoya, Tochigi Pref. ; Mt. Kogashi, Tochigi

\* Faculty of Pharmaceutical Sciences, Science University of Tokyo, Shinjuku-ku, Tokyo 162. 東京理科大学 薬学部。

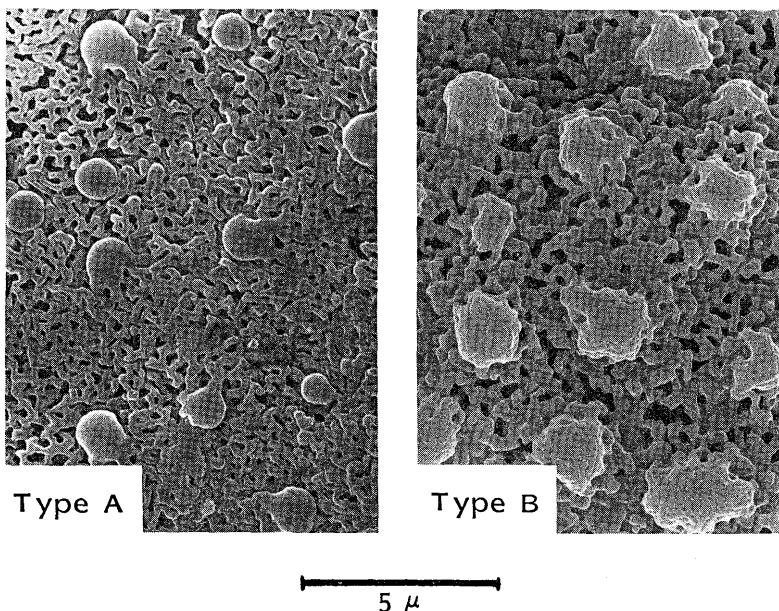


Fig. 1. Variation in the exine ornamentation of *Asiasarum sieboldii*.

Pref. ; Mt. Tanigawa, Gunma Pref. ; Hoshi, Gunma Pref. ; Mt. Kuroiwa, Nagano Pref. ; Oami, Nagano Pref. ; Mt. Tamamine, Shimane Pref. ; Kamiai, Shimane Pref. ; Taishaku, Hiroshima Pref. ; and Mt. Kura, Kumamoto Pref. On the other hand, the type B pollen was observed in the following samples (Fig. 3) : Tochu, Niigata Pref. ; Kawaji, Tochigi Pref. ; Terama, Gunma Pref. ; Mt. Mitsu-mine, Saitama Pref. ; Mt. Mitsutoge, Yamanashi Pref. ; Mt. Asahi, Nagano Pref. ; Koda, Nagano Pref. ; Inakita, Nagano Pref. ; Chiyo, Nagano Pref. ; Toga, To-yama Pref. ; Mt. Shiritaka, Ishikawa Pref. ; Mt. Ibuki, Gifu Pref. ; Uogataki, Hyogo Pref. ; Mt. Juho, Tottori Pref. ; Hagami, Shimane Pref. ; Mt. Mitake, Nagasaki Pref. It was also observed in *A. sieboldii* from Liao-Ning, China.

The type A pollen was observed in *A. heterotropoides* from the following localities (Fig. 4) : Asahikawa, Hokkaido ; Kotoni, Hokkaido ; Zenibako, Hokkaido ; Mt. Hakkoda, Aomori Pref. ; Mt. Taihei, Akita Pref. ; Mt. Koma, Akita Pref. The same type was found in both *A. heterotropoides* var. *seoulense* from Seoul, Korea and *A. heterotropoides* var. *mandshuricum* from Liao-Ning, China.

The type B pollen, however, was not found within *A. heterotropoides* and its varieties.

On the other hand, the type B pollen was also observed in *A. dimidiatum* from the following localities (Fig. 5): Mt. Kotsu, Tokushima Pref.; Mt. Saragamine, Ehime Pref.; Mt. Sobo, Oita Pref.; and Mt. Kunimi, Kumamoto Pref. The Type A pollen, however, was not found within this species.

**Discussion** The ornamentation of pollen grains in the genus *Asiasarum* can be classified into two types. One of the two types is characterized by the smooth surface of the verruca. *A. heterotropoides* and *A. sieboldii*, both distributed in northern regions, have this type of pollen. The type A pollen seems to be associated with taxa with northern distribution. It is also noteworthy that *A. sieboldii* from the inland of the San'in district (Shimane and Hiroshima Pref.) and from the Aso mountain range (Kumamoto Pref.) have this type.

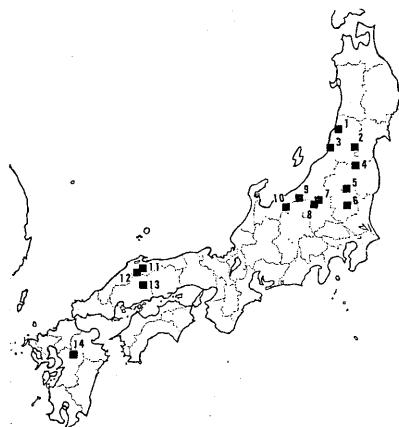


Fig. 2. Localities of *A. sieboldii* having the type A pollen. 1, Yutagawa (Yamagata Pref.); 2, Mt. Zao (Yamagata Pref.); 3, Murakami (Niigata Pref.); 4, Tsuchiyu (Fukushima Pref.); 5, Sandogoya (Tochigi Pref.); 6, Mt. Kogashi (Tochigi Pref.); 7, Mt. Tanigawa (Gunma Pref.); 8, Hoshi (Gunma Pref.); 9, Mt. Kuroiwa (Nagano Pref.); 10, Oami (Nagano Pref.); 11, Mt. Tamamine (Shimane Pref.); 12, Kamiai (Shimane Pref.); 13, Taishaku (Hiroshima Pref.); 14, Mt. Kura (Kumamoto Pref.).

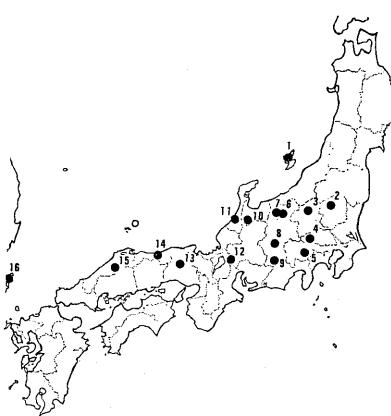


Fig. 3. Localities of *A. sieboldii* having the type B pollen. 1, Tochu (Niigata Pref.); 2, Kawaji (Tochigi Pref.); 3, Terama (Gumma Pref.); 4, Mt. Mitsumine (Saitama Pref.); 5, Mt. Mitsutoge (Yamanashi Pref.); 6, Mt. Asahi (Nagano Pref.); 7, Koda (Nagano Pref.); 8, Inakita (Nagano Pref.); 9, Chiyo (Nagano Pref.); 10, Toga (Toyanma Pref.); 11, Mt. Shirataka (Ishikawa Pref.); 12, Mt. Ibuki (Gifu Pref.); 13, Uogataki (Hyogo Pref.); 14, Mt. Juho (Tottori Pref.); 15, Hagami (Shimane Pref.); 16, Mt. Mitake (Nagasaki Pref.).

The other type is characterized by the striate surface of the verruca. *A. sieboldii* from south-western Honshu and Tsushima (Nagasaki Pref.) and *A. dimidiatum* have this type of pollen. These facts suggest that this pollen type is characteristic of the south-western taxa of *Asiasarum*.

As reported before (Nakamura et al. 1987), three monoterpenoid patterns were found for the essential oils of the Japanese *Asiasarum*. Both *A. sieboldii* from northern Honshu and *A. heterotropoides* with the type A pollen produces eucarvone. Both *A. sieboldii* from south-western Honshu and *A. dimidiatum* with the type B pollen are characterized by a monoterpenoid pattern of 1,8-cineol,  $\alpha$ -terpineol and terpinenol-4. However, some materials of *A. sieboldii* from the inland of the San'in district have the type A pollen and the monoterpenoid pattern of 1,8-cineol,  $\alpha$ -terpineol and terpinenol-4 and those from the Aso mountain range (Kumamoto Pref., Kyushu) have the type A pollen and a monoterpenoid pattern of borneol, eucarvone, 1,8-cineol,  $\alpha$ -terpineol and terpinenol-4. Thus, the type A pollen seems to be associated with a monoterpenoid pattern of eucarvone found in *A. heterotropoides* and *A. sieboldii* from northern Honshu and the type B pollen with a monoterpenoid pattern of 1,8-cineol,  $\alpha$ -terpineol and terpinenol-4 in *A. dimidiatum* and *A. sieboldii* from south-western Japan. However, *A. sieboldii* from San'in district and the Aso mountain range

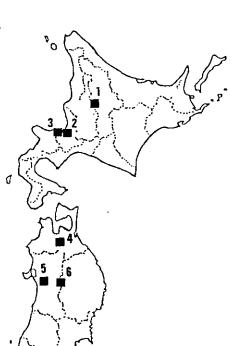


Fig. 4. Localities of *A. heterotropoides* having the type A pollen. 1, Asahikawa (Hokkaido); 2, Kotoni (Hokkaido); 3, Zenibako (Hokkaido); 4, Mt. Hakkoda (Aomori Pref.); 5, Mt. Taihei (Akita Pref.); 6, Mt. Koma (Akita Pref.).



Fig. 5. Localities of *A. dimidiatum* having the type B pollen. 1, Mt. Kotsu (Tokushima Pref.); 2, Mt. Saragamine (Ehime Pref.); 3, Mt. Sobo (Oita Pref.); 4, Mt. Kunimi (Kumamoto Pref.).

has the type A pollen as in materials from northern Honshu, but shows different monoterpenoid patterns as mentioned above. It should be noted here that *A. sieboldii* with type A pollen shows distribution pattern similar to that of some boreal and/or continental elements reported by Hara (1959) and Hotta (1974), even though it produces different monoterpenoids in western Japan.

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日本産ウスバサイシン属植物の花粉の外壁彫紋を走査電子顕微鏡を用いて比較した。これらの花粉の外壁彫紋は、散在する疣状紋の表面の紋様の有無によって、2型に大別された。疣状紋の表面に紋様のない型は北海道、東北地方に分布するオクエゾサイシン、ならびに中部以北の本州、山陰地方内陸部、熊本県で採集したウスバサイシンに認められた。これに対して、疣状紋の表面に線状紋がある型は紀伊半島、四国、九州に分布するクロフネサイシン、ならびに中部以西の本州（山陰地方内陸部の一部を除く）と対島で採集したウスバサイシンで認められた。